

# **Structural Assessment of Plaquemines Parish, Louisiana After Hurricane Katrina**

**by**

Structural Safety Assessment –  
Planning and Response Team

U.S. Army Corps of Engineers

Buffalo District & Huntington District

11/6/05 – 11/28/05

# SSA-PRT Plaquemines Parish Introduction

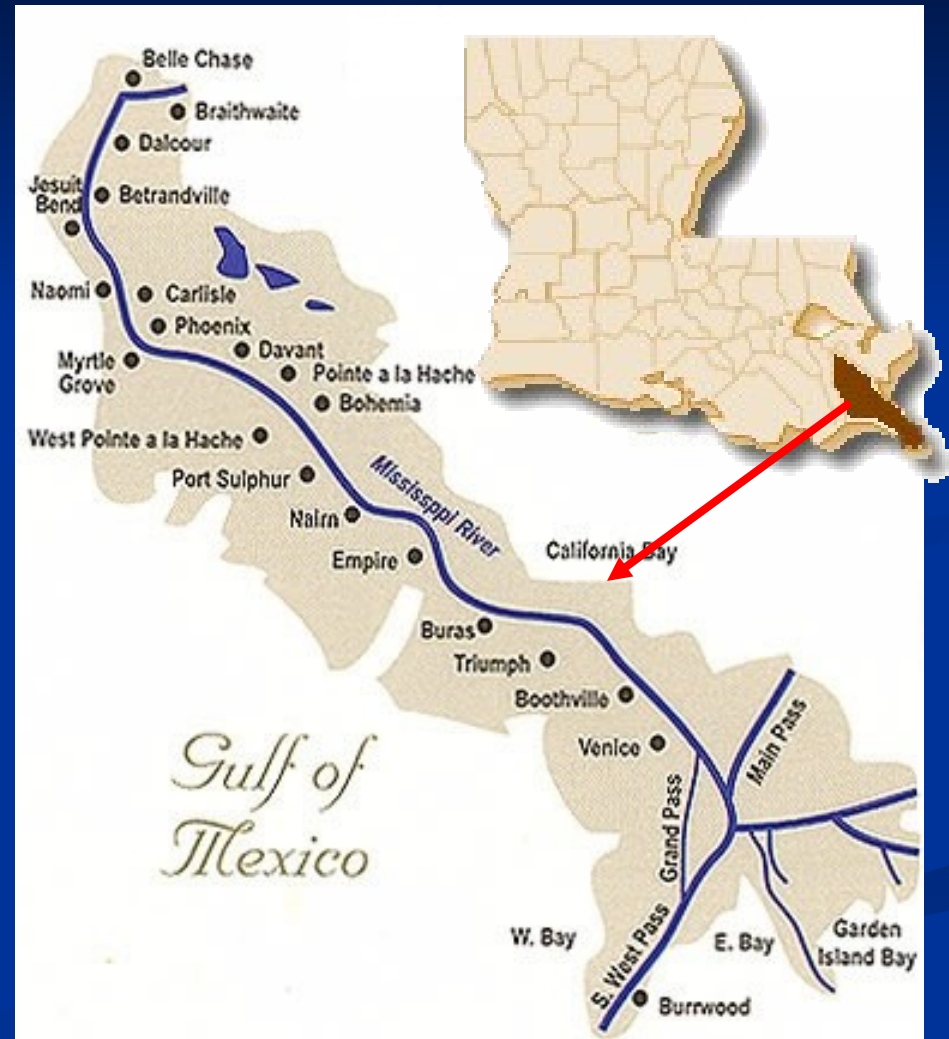
- Plaquemines Parish general information
- Hurricane Katrina and Rita data
- Post Katrina and Rita damage
- Explain assessment process
- Give examples of assessments
- Show results from mission
- Lessons learned





# SSA-PRT Plaquemines Parish

- Plaquemines is Louisiana's southernmost parish where the Mississippi River meets the Gulf of Mexico
- The parish has a population of approximately 27,000, a land area of 845 square miles, and is approximately 65 miles long and  $\frac{3}{4}$  mile wide at its widest point
- The parish main sources of income are from fishing, recreation and oil



# SSA-PRT Plaquemines Parish

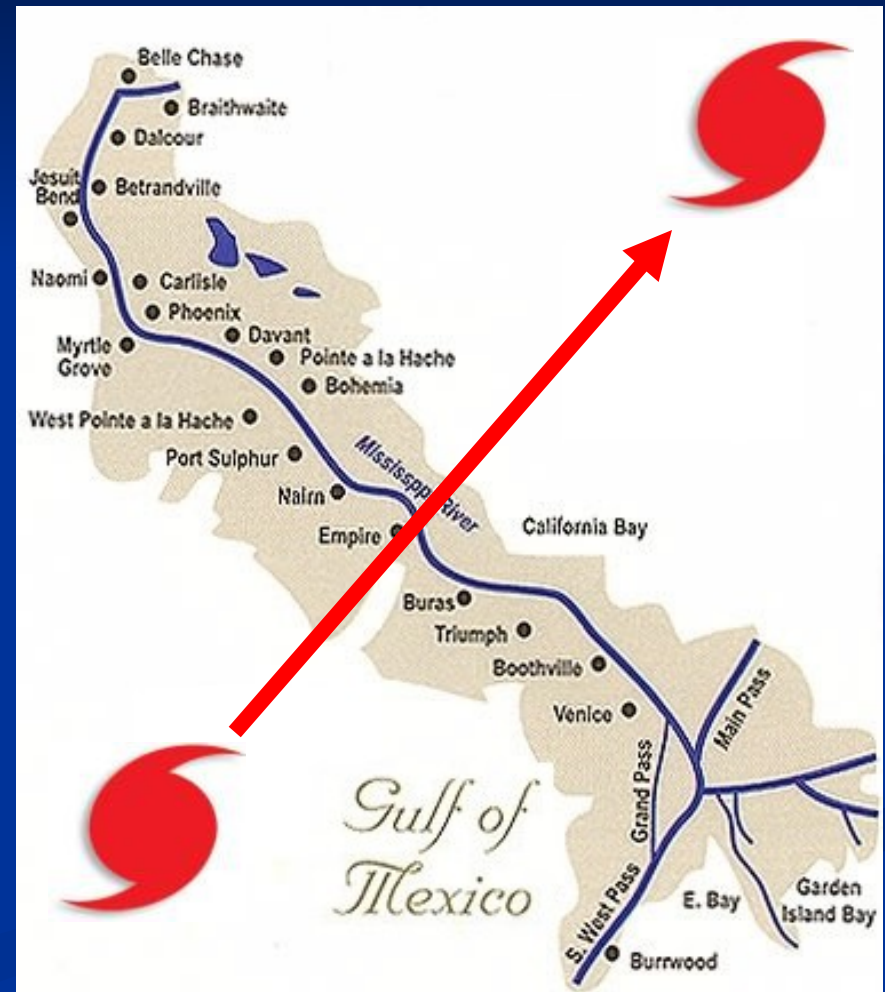
## Hurricane Katrina

- Made landfall on August 29<sup>th</sup>, 2005 as a Category 3 (was Category 5) storm with winds up to 125 mph and a storm surge of up to 22 ft
- Caused an estimated \$75 billion in damages (costliest hurricane in U.S. history)
- Killed 1,418 people (deadliest hurricane since 1928)



# SSA-PRT Plaquemines Parish

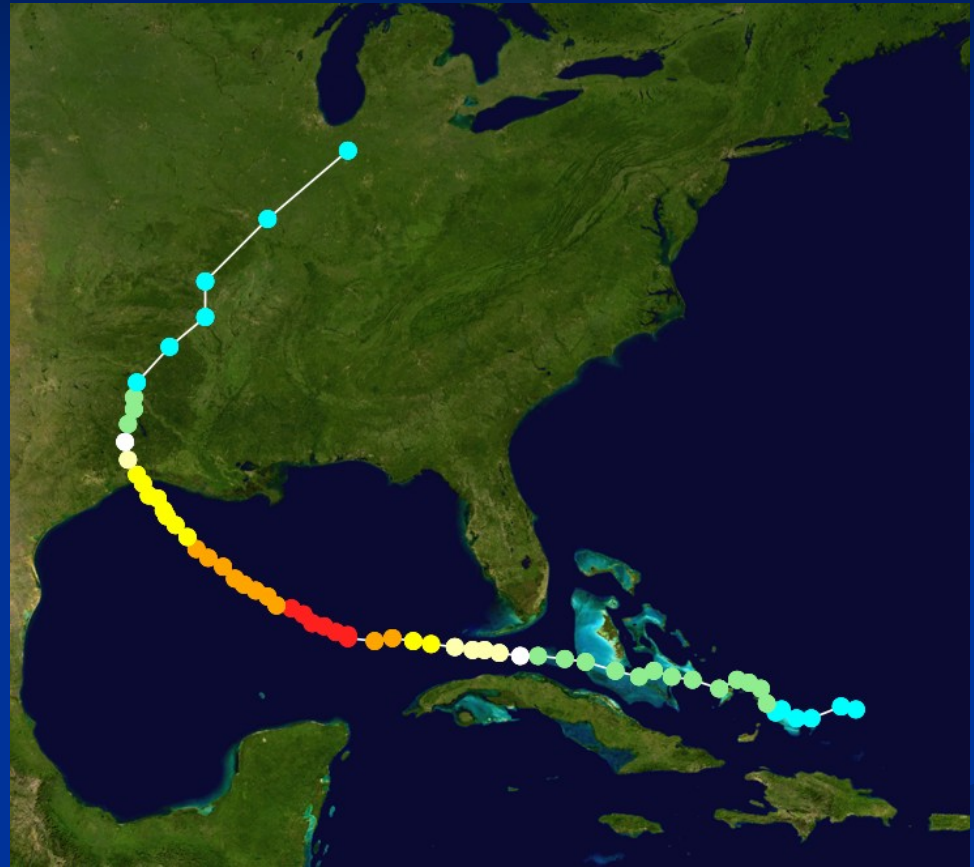
- The eye of Hurricane Katrina passed directly through the middle of Plaquemines Parish
- Plaquemines was also affected by Hurricane Rita
- Levees run on either side of the Mississippi River as well as along Gulf side of the parish
- Overtopping of Mississippi River caused levee failure, surge damage and flooding



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## Hurricane Rita

- Made landfall on September 24, 2005 as a Category 3 (was Category 5) with winds up to 125 mph and a 7 ft storm surge in Texas (15-20 ft in Louisiana)
- Caused an estimated \$9 billion in damages
- Killed 6 people directly and 113 indirectly
- Re-flooded parts of Louisiana hit by Katrina





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## Levee Break



# SSA-PRT Plaquemines Parish

## Levee Cross Section



# SSA-PRT Plaquemines Parish

## Levee Break





# SSA-PRT Plaquemines Parish

## Levee Break



# SSA-PRT Plaquemines Parish

## Levee Break





# SSA-PRT Plaquemines Parish

## Levee Break



# SSA-PRT Plaquemines Parish

## Buras High School





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## Parish Prison



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## Task:

- “Structural Assessment Team – Requesting Corps of Engineers Structural Safety Assessment Team for Plaquemines Parish to assess structural integrity of public (PA) and residential (IA) property. Approximately 4500 structures. Need to identify those structures which may be feasibly repaired or require demolition.”
- Actually 6500 inspections done
- Public property (i.e. government buildings, schools, etc.) was later taken off of mission statement
- Some commercial structures were evaluated if Right-of-Entry was obtained and inspection requested

# SSA-PRT Plaquemines Parish

## ASSESSMENT PROCESS

- Rapid Assessments
- Visual Assessments
- Obtain Rights of Entry (R.O.E.)
- Detailed Residential Assessments
- Detailed Commercial Assessments
- Determine if “**Structure Appears Sound**”, “**More Investigation Needed**”, or “**Structure Appears Unsound**”





# SSA-PRT Plaquemines Parish

## Rapid Assessment



### PLAQUEMINES PARISH RAPID STRUCTURAL ASSESSMENT

#### RAPID STRUCTURAL ASSESSMENTS:

|                            |                  |                             |                             |
|----------------------------|------------------|-----------------------------|-----------------------------|
| Inspector(s)               | Inspection Date: |                             |                             |
| Affiliation: USACE SSA PRT | Inspection Time: | <input type="checkbox"/> AM | <input type="checkbox"/> PM |

#### BUILDING INFORMATION:

Building Name/Owner:

Building Type:

Address:

Number of Stories:

Number of Residential Units:

Footprint area:

#### OVERALL STRUCTURAL DAMAGE:

Structure not present on lot:

☐ Yes ☐ No

Collapse or partial collapse:

☐ None/Minor ☐ Moderate ☐ Severe

Building or story leaning:

☐ None/Minor ☐ Moderate ☐ Severe

Foundation failure:

☐ None/Minor ☐ Moderate ☐ Severe

Structure displaced from foundation:

☐ None/Minor ☐ Moderate ☐ Severe

Structure damaged by:

☐ Wind ☐ Water ☐ Fire

#### DETERMINATION:

☐ Primary structural components are sound.

☐ More structural evaluation is necessary.

☐ Primary structural components unsound.

Comments:

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SIGNATURE: \_\_\_\_\_

DATE: \_\_\_\_\_

# SSA-PRT Plaquemines Parish

## Rapid Assessment





# SSA-PRT Plaquemines Parish

## Rapid Assessment





# SSA-PRT Plaquemines Parish

## Rapid Assessment





# SSA-PRT Plaquemines Parish

## Rapid Assessment





# SSA-PRT Plaquemines Parish

## Rapid Assessment





# SSA-PRT Plaquemines Parish

## Visual Inspections

### Visual Inspections

- Properties and homes that were no longer present or already collapsed





# SSA-PRT Plaquemines Parish

## Visual Inspections





# SSA-PRT Plaquemines Parish

## Visual Inspections





# SSA-PRT Plaquemines Parish

## Visual Inspections







# SSA-PRT Plaquemines Parish

## Detailed Residential Assessment



### PLAQUEMINES PARISH DETAILED RESIDENTIAL STRUCTURAL ASSESSMENT

Sagging roof sheathing/decking:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

Missing/damaged roof sheathing/decking and/or soffit:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

Missing/damaged roof framing:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

Gable and/or hip framing detached from top sill plate of walls:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

#### EXTERIOR WALLS:

Structural sheathing on wall missing/damaged:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

Wall framing racked:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:



### PLAQUEMINES PARISH DETAILED RESIDENTIAL STRUCTURAL ASSESSMENT

Wall framing leaning:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

Estimated amount out of plumb:

☐1" over 8' ☐2 to 3" over 8' ☐4 to 6" over 8' ☐ > 6" over 8' ☐N/A

Wall sole plate detached from floor joist or vertical studs detached from wall sole plate:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

Wall Framing collapsed:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

#### GARAGE/OTHER OUT BUILDINGS:

Type:

☐Attached ☐Detached ☐Carport ☐None

Extent of damage to garage:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

#### FOUNDATION:

Foundation type:

☐slab on grade ☐sill on piers ☐sill on concrete/block wall ☐other

Comments:



# SSA-PRT Plaquemines Parish

## Detailed Residential Assessment



### PLAQUEMINES PARISH DETAILED RESIDENTIAL STRUCTURAL ASSESSMENT

Sill plate sagging/damaged:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

Floor joists sagging/damaged:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

Floor joist detached from sill plate:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

Damage to main girder or main girder unsupported:

☐None/Minor ☐Moderate ☐Severe ☐N/A ☐Unknown

Comments:

Piers or concrete/block wall out of plumb:

☐None/Minor ☐Moderate ☐Severe ☐N/A

Comments:

Estimated amount out of plumb:

☐1" over 2' ☐2 to 3" over 2' ☐4 to 6" over 2' ☐ > 6" over 2'



### PLAQUEMINES PARISH DETAILED RESIDENTIAL STRUCTURAL ASSESSMENT

Floor sheathing sagging/damaged:

☐None/Minor ☐Moderate ☐Severe ☐N/A ☐Unknown

Comments:

If wood frame structure, evidence of damage by structural pests (wood-boring insects).

Indicate in comments if damage to sill plate, floor joists, joist header, superstructure framing:

☐None/Minor ☐Moderate ☐Severe ☐N/A ☐Unknown

Comments:

Type of damage to foundation:

☐scour/erosion ☐displacement ☐settlement ☐fracture ☐penetration ☐other

Comments:

Sill plate connection to foundation:

☐anchor bolts ☐through-bolts (pile) ☐gravity ☐other

Comments:

Condition/extent of damage to sill plate-foundation connection:

☐displacement ☐separation (prying or rotation) ☐fracture ☐other

Comments:

# SSA-PRT Plaquemines Parish

## Detailed Residential Assessment





# SSA-PRT Plaquemines Parish

## Detailed Residential Assessment





# SSA-PRT Plaquemines Parish

## Detailed Residential Assessment





# SSA-PRT Plaquemines Parish

## Detailed Commercial Assessment



### PLAQUEMINES PARISH DETAILED COMMERCIAL STRUCTURAL ASSESSMENT

|                    |                  |                             |                             |
|--------------------|------------------|-----------------------------|-----------------------------|
| Inspector(s):      | Inspection Date: |                             |                             |
| Affiliation: USACE | Inspection Time: | <input type="checkbox"/> AM | <input type="checkbox"/> PM |

#### BUILDING INFORMATION:

|                                                                         |                                     |                                               |                                             |                                          |                                   |
|-------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------|---------------------------------------------|------------------------------------------|-----------------------------------|
| Building Name/Owner:                                                    |                                     |                                               |                                             |                                          |                                   |
| Address:                                                                |                                     |                                               |                                             |                                          |                                   |
| Building Type:                                                          | <input type="checkbox"/> Wood Frame | <input type="checkbox"/> Unreinforced Masonry | <input type="checkbox"/> Reinforced Masonry | <input type="checkbox"/> Steel Frame     | <input type="checkbox"/> Other    |
| Number of Stories:                                                      | <input type="checkbox"/> 1          | <input type="checkbox"/> 1.5                  | <input type="checkbox"/> 2                  | <input type="checkbox"/> 3               | <input type="checkbox"/> Other    |
| Primary Occupancy                                                       | <input type="checkbox"/> Dwelling   | <input type="checkbox"/> Commercial           | <input type="checkbox"/> Offices            | <input type="checkbox"/> Government      | <input type="checkbox"/> Historic |
|                                                                         | <input type="checkbox"/> Industrial | <input type="checkbox"/> School               | <input type="checkbox"/> Emergency Services | <input type="checkbox"/> Public Assembly | <input type="checkbox"/> Other:   |
| "Footprint Area" (ft <sup>2</sup> )                                     |                                     |                                               |                                             |                                          |                                   |
| Parcel Number (if known):                                               |                                     |                                               |                                             |                                          |                                   |
| GPS Coordinates (if known):                                             |                                     |                                               |                                             |                                          |                                   |
| Estimated Flood Elevation Above Finished First Floor (to nearest foot): |                                     |                                               |                                             |                                          |                                   |

#### DETERMINATION:

- ☐ Primary Structural Components Appear Sound.  
☐ Structural System Unsound.  
☐ Other Commentary (if necessary):

SIGNATURE: \_\_\_\_\_

DATE: \_\_\_\_\_

NOTE: THIS ASSESSMENT DOES NOT CONSIDER NONSTRUCTURAL FEATURES AND IS NOT A SAFETY/HAZARD ASSESSMENT OF THE STRUCTURE. OTHER UNSAFE CONDITIONS OR HAZARDS MAY STILL BE PRESENT.



### PLAQUEMINES PARISH DETAILED COMMERCIAL STRUCTURAL ASSESSMENT

#### Evaluation

Investigate the building for the conditions below and check the appropriate column.

#### Overall Building Stability:

- Collapse or partial collapse ☐ None/Minor ☐ Moderate ☐ Severe
- Fractured or displaced foundation ☐ None/Minor ☐ Moderate ☐ Severe
- Large object leaning/resting on structure or possibility of falling on structure ☐ None/Minor ☐ Moderate ☐ Severe
- Small debris washed into or coming to rest against building or foundation ☐ None/Minor ☐ Moderate ☐ Severe

Comments: \_\_\_\_\_

#### Structural Hazards:

##### Vertical Load Carrying Members

- Columns, piers, or walls substantially out of plumb ☐ None/Minor ☐ Moderate ☐ Severe
- Buckled, bowed, or failed columns, piles, piers, or bearing walls ☐ None/Minor ☐ Moderate ☐ Severe
- Roof or floor substantially damaged or separated from walls or vertical supports ☐ None/Minor ☐ Moderate ☐ Severe
- Damaged or failed connections between super-structure and foundation ☐ None/Minor ☐ Moderate ☐ Severe
- Failure of significant vertical load carrying element ☐ None/Minor ☐ Moderate ☐ Severe

Comments: \_\_\_\_\_

##### Lateral Load Carrying Members

- Broken, leaning, or seriously degraded moment frames ☐ None/Minor ☐ Moderate ☐ Severe
- Severely cracked shear walls ☐ None/Minor ☐ Moderate ☐ Severe
- Broken or buckled vertical braces ☐ None/Minor ☐ Moderate ☐ Severe
- Broken or seriously damaged diaphragms or horizontal bracing ☐ None/Minor ☐ Moderate ☐ Severe
- Damage or failure of wall/floor connections, wall/roof connections, or bracing connections ☐ None/Minor ☐ Moderate ☐ Severe
- Failure of significant lateral load carrying element ☐ None/Minor ☐ Moderate ☐ Severe

Comments: \_\_\_\_\_

##### Foundation Damage

- Building pulled apart or differentially settled ☐ None/Minor ☐ Moderate ☐ Severe
- Significant portion of shallow foundation undermined, with signs of settlement, cracking, or failure ☐ None/Minor ☐ Moderate ☐ Severe
- Erosion or local scour around foundation ☐ None/Minor ☐ Moderate ☐ Severe
- Fractured foundation piers, piles, or slabs ☐ None/Minor ☐ Moderate ☐ Severe
- Damage to foundations connection ☐ None/Minor ☐ Moderate ☐ Severe
- Sedimentation inside or against building that is adversely affecting structure ☐ None/Minor ☐ Moderate ☐ Severe

Comments: \_\_\_\_\_

##### Roof Damage

- Sagging ridge ☐ None/Minor ☐ Moderate ☐ Severe
- Bowed sheathing/roof decking ☐ None/Minor ☐ Moderate ☐ Severe





# SSA-PRT Plaquemines Parish

## Detailed Commercial Assessment





# SSA-PRT Plaquemines Parish

## Detailed Commercial Assessment





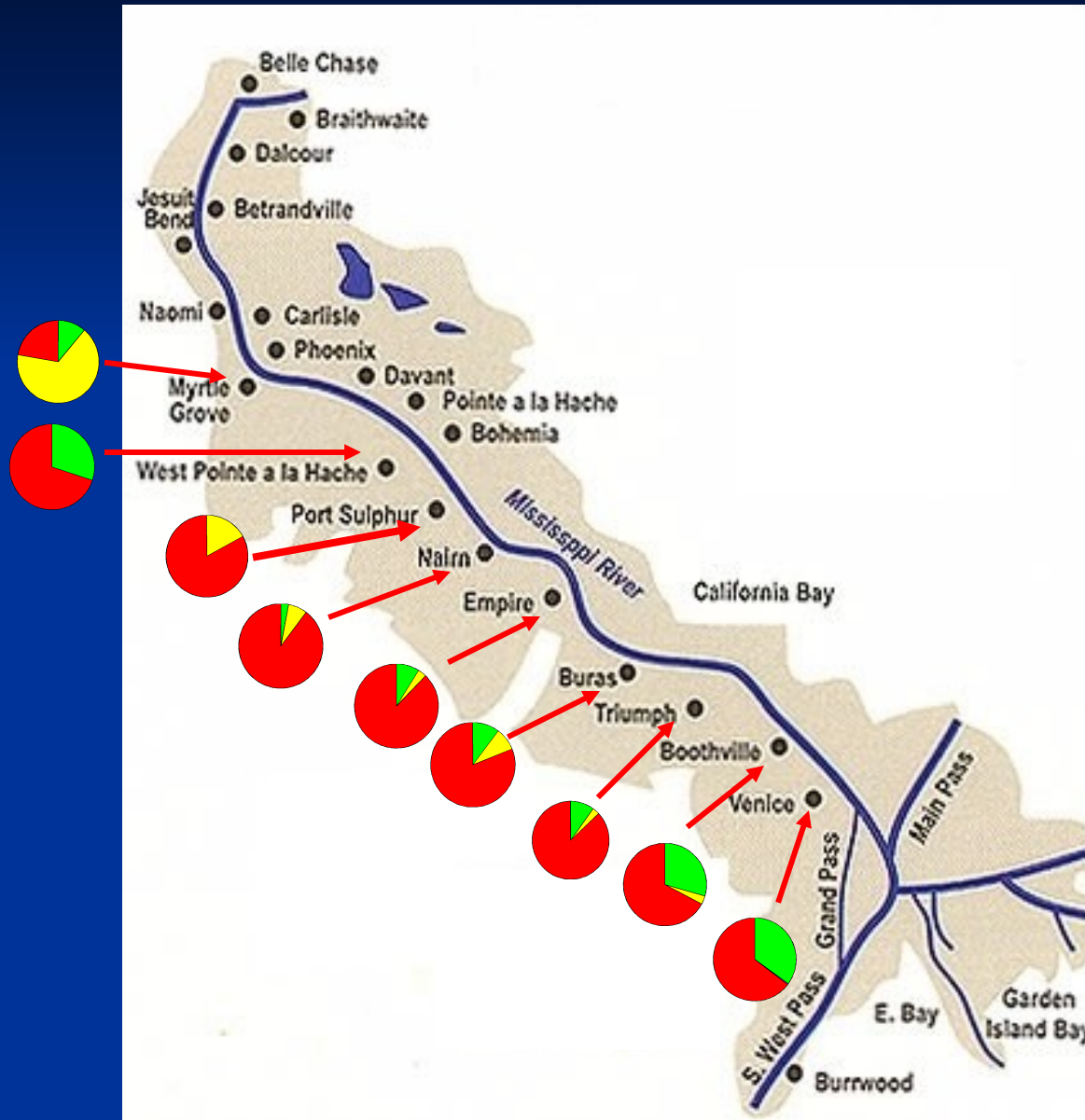
# SSA-PRT Plaquemines Parish

## Results for West Bank

| Area           | Rapid Insp. | Detailed Insp. | Visual Insp. | Structure Appears Sound | More Invs. Needed | Structure Appears Unsound |
|----------------|-------------|----------------|--------------|-------------------------|-------------------|---------------------------|
| Ironton        | 0           | 6              | 0            | 2                       | 0                 | 4                         |
| Myrtle Grove   | 8           | 1              | 0            | 1                       | 6                 | 2                         |
| West Point     | 5           | 5              | 0            | 3                       | 0                 | 7                         |
| Diamond        | 58          | 8              | 0            | 5                       | 6                 | 55                        |
| Happy Jack     | 94          | 20             | 0            | 41                      | 35                | 38                        |
| Enclade        | 276         | 7              | 70           | 5                       | 30                | 318                       |
| Potash         | 102         | 10             | 262          | 5                       | 30                | 339                       |
| Port Sulphur   | 33          | 1              | 49           | 0                       | 14                | 69                        |
| Homeplace      | 112         | 10             | 69           | 3                       | 34                | 154                       |
| Bremond        | 198         | 14             | 228          | 34                      | 39                | 367                       |
| Nairn          | 200         | 6              | 95           | 9                       | 22                | 270                       |
| Empire         | 207         | 12             | 522          | 65                      | 25                | 651                       |
| Tropical Bend  | 55          | 0              | 132          | 0                       | 0                 | 187                       |
| Buras          | 507         | 20             | 504          | 107                     | 88                | 836                       |
| Triumph        | 76          | 1              | 175          | 25                      | 8                 | 219                       |
| Boothville     | 565         | 8              | 576          | 338                     | 38                | 773                       |
| Venice         | 158         | 20             | 144          | 113                     | 1                 | 208                       |
| <b>TOTALS:</b> | <b>2654</b> | <b>149</b>     | <b>2826</b>  | <b>756</b>              | <b>376</b>        | <b>4497</b>               |

# SSA-PRT Plaquemines Parish

## Results for West Bank



**Structure Appears Unsound**

**More Investigation Needed**

**Structure Appears Sound**



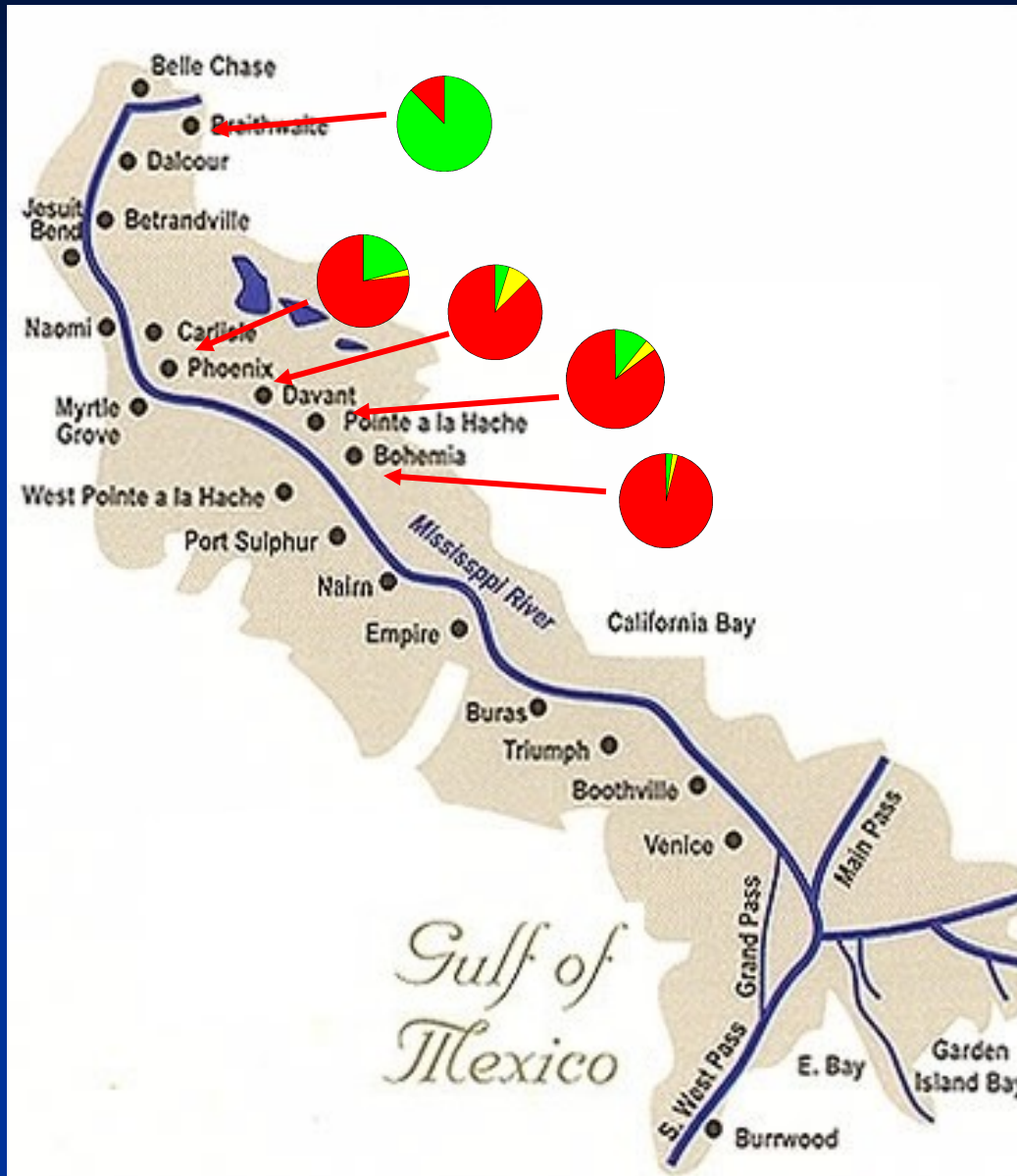
# SSA-PRT Plaquemines Parish

## Results for East Bank

| Area             | Rapid Insp. | Detailed Insp. | Visual Insp. | Structure Appears Sound | More Invs. Needed | Structure Appears Unsound |
|------------------|-------------|----------------|--------------|-------------------------|-------------------|---------------------------|
| Point-a-la-Hache | 59          | 2              | 181          | 27                      | 9                 | 206                       |
| Phoenix          | 183         | 7              | 40           | 48                      | 5                 | 177                       |
| Davant           | 95          | 3              | 122          | 11                      | 17                | 192                       |
| Harlem           | 22          | 0              | 25           | 1                       | 1                 | 45                        |
| Belair/Carlisle  | 18          | 0              | 0            | 7                       | 1                 | 10                        |
| Braithwaite      | 0           | 8              | 0            | 7                       | 0                 | 1                         |
|                  |             |                |              |                         |                   |                           |
|                  |             |                |              |                         |                   |                           |
|                  |             |                |              |                         |                   |                           |
| <b>TOTALS:</b>   | <b>377</b>  | <b>20</b>      | <b>368</b>   | <b>101</b>              | <b>33</b>         | <b>631</b>                |

# SSA-PRT Plaquemines Parish

## Results for East Bank



- Structure Appears Unsound
- More Investigation Needed
- Structure Appears Sound



# SSA-PRT Plaquemines Parish

## Overall Results

| Area         | Rapid Insp. | Detailed Insp. | Visual Insp. | Structure Appears Sound | More Investigation Needed | Structure Appears Unsound |
|--------------|-------------|----------------|--------------|-------------------------|---------------------------|---------------------------|
| East Bank    | 377         | 20             | 368          | 101                     | 33                        | 631                       |
| West Bank    | 2654        | 149            | 2826         | 756                     | 375                       | 4497                      |
| <b>Total</b> | <b>3031</b> | <b>169</b>     | <b>3194</b>  | <b>857</b>              | <b>408</b>                | <b>5128</b>               |

# SSA-PRT Plaquemines Parish

## QUESTIONS???

